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A Comprehensive Review of Diabetes Mellitus: From Pathogenesis to Patient-Centred Team Care

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Abstract:

Persistent hyperglycemia is a hallmark of diabetes mellitus (DM), a chronic metabolic disease. It could be brought on by resistance to the peripheral effects of insulin, decreased insulin production, or both. In patients with diabetes mellitus, chronic hyperglycemia combined with other metabolic abnormalities can harm multiple organ systems and result in life-threatening and incapacitating health complications. The most common of these are microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (an increased risk of cardiovascular diseases by two to four times). The pathophysiology of DM is reviewed in this exercise, which also emphasizes the interprofessional team's involvement in managing the condition.

Objectives:

- Explain the causes of diabetes mellitus.
- Review diabetes mellitus's pathogenesis.
- List the various diabetes mellitus treatment options.
- Examine the significance of enhancing interprofessional team members' care coordination in order to enhance outcomes for patients with type 2 diabetes.

Introduction

Persistent hyperglycaemia is a hallmark of diabetes mellitus (DM), a chronic metabolic disease. It could be brought on by resistance to the peripheral effects of insulin, decreased insulin production, or both. About 415 million persons aged 20 to 79 had diabetes mellitus in 2015, according to the International Diabetes Federation (IDF). [1] Given that this number is predicted to increase to an additional 200 million by 2040, diabetes mellitus is proving to be a global public health concern. [1] In patients with diabetes mellitus, chronic hyperglycemia combined with other metabolic abnormalities can harm multiple organ systems and result in life-threatening and incapacitating health complications. The most common of these are microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (an increased risk of cardiovascular diseases by two to four times). We give a summary of the pathophysiology, diagnosis, clinical manifestation, and management guidelines for diabetes in this review.

Etiology:

Type 1 diabetes, type 2 diabetes, and gestational diabetes mellitus (GDM) are the three main categories of diabetes mellitus based on their origin and clinical manifestation. Secondary diabetes and monogenic diabetes are two more, less prevalent forms of the disease. [2] [3] [4] [5]

Type 1 Diabetes Mellitus (T1DM)

A combination of genetic predisposition and environmental factors, such as viral infection, toxins, or certain dietary factors, have been implicated as triggers for autoimmunity. Type 1 diabetes mellitus (T1DM), which makes up 5% to 10% of DM, is characterized by the autoimmune destruction of insulin-producing beta cells in the pancreatic islets, resulting in an absolute deficiency of insulin. T1DM is most commonly observed in children and adolescents, but it can develop at any age.

Type 2 Diabetes Mellitus

The majority of diabetes cases (around 90%) are type 2 diabetic mellitus (T2DM). Insulin resistance is the term used to describe the reduced response to insulin in type 2 diabetes. Insulin is inefficient in this state, and in order to maintain glucose homeostasis, insulin production first rises. However, over time, insulin production falls, leading to type 2 diabetes. The majority of people with type 2 diabetes are over 45. However, because of the rise in obesity, physical inactivity, and energy-dense meals, it is becoming more prevalent among kids, teens, and young adults.

Gestational Diabetes Mellitus

Gestational diabetes mellitus (GDM), commonly referred to as hyperglycemia in pregnancy, is the term used to describe hyperglycemia that is initially identified during pregnancy. GDM typically affects pregnant women in the second and third trimesters, while it can happen at any time. The American Diabetes Association (ADA) estimates that 7% of pregnancies are complicated with GDM. Type 2 diabetes mellitus is more likely to develop in the future in women with GDM and their children.

Monogenic Diabetes

This kind of diabetes is brought on by a single genetic mutation in an autosomal dominant gene. Neonatal diabetes mellitus and maturity-onset diabetes of the young (MODY) are two instances of monogenic diabetes. Monogenic diabetes accounts for 1–5% of all instances of diabetes. A family condition, MODY often manifests before the age of 25.

Secondary Diabetes

The complications of other pancreatic disorders (like pancreatitis), hormone imbalances (like Cushing disease), or medications (like corticosteroids) might result in secondary diabetes.

Epidemiology:

Diabetes is a global health crisis. The prevalence of diabetes mellitus has risen globally due to shifting lifestyles and rising obesity rates. 425 million people worldwide had diabetes mellitus in 2017. About 10% of Americans had diabetes in 2015, according to the International Diabetes Federation (IDF). Seven

million of these went undiagnosed. The prevalence of diabetes mellitus rises with age. People over 65 who have diabetes make up about 25% of the population. [5]

Pathophysiology:

Pancreatic beta cells are destroyed by an autoimmune process that is cellularly driven in type 1 diabetes. There is a significant hereditary tendency to T1DM. It is estimated that between 40 and 50 percent of the familial aggregation of type 1 diabetes is caused by the major histocompatibility complex (MHC), sometimes referred to as human leukocyte antigens (HLA). Ninety percent of T1DM patients have polymorphisms in the class II HLA genes that encode DQ and DR4-DQ8, with DR3-DQ2 being one of the important factors.

Latent autoimmune diabetes of adults (LADA) is another type of type 1 diabetes. It usually starts later in life and happens in maturity.

In general, children and adults demolish things more quickly. These individuals may have blood autoantibodies against zinc transporter 8 (Zn T8), insulin, glutamic acid decarboxylase-65 (GAD-65), and islet cells. Particularly after the first year, these antibodies lose their diagnostic efficacy over time and lack the diagnostic precision to be regularly employed for diagnosis. Insulin secretion is reduced or ceases entirely as beta cells gradually die. Most of these patients are not fat. Other autoimmune conditions like Addison's disease, Graves disease, Hashimoto thyroiditis, and celiac disease are more likely to strike them. Idiopathic T1DM is a subtype of the disease that is not linked to insulin autoimmunity or the aforementioned HLA. It manifests as episodic diabetic ketoacidosis (DKA) and is more prevalent in Asian and African populations.

Insulin resistance and beta-cell dysfunction are two characteristics of type 2 diabetes. Insulin secretion first rises in response, keeping blood glucose levels within the normal range. Hyperglycemia is caused by beta cell alterations and insulin secretion's inability to maintain glucose homeostasis as the condition worsens. Obesity or a higher body fat percentage, primarily in the abdominal area, characterizes the majority of T2DM patients. Through a number of inflammatory processes, such as elevated FFA release and adipokine dysregulation, this adipose tissue itself contributes to insulin resistance. The risk of acquiring type 2 diabetes is further increased by a lack of physical activity, dyslipidemia, or previous GDM in those with hypertension. Emerging evidence points to the involvement of inflammation, adipokine dysregulation, hyperglucagonemia, increased renal glucose reabsorption, aberrant gut microbiota, and aberrant incretin biology with reduced incretins such glucagon-like peptide-1 (GLP-I) or incretin resistance.

History and Physical:

The most common symptoms of diabetes mellitus include increased thirst, increased urination, exhaustion and lack of energy, fungal and bacterial infections, and delayed wound healing. Additionally, some individuals may experience impaired vision or numbness or tingling in their hands or feet. These people may experience mild hyperglycaemia, which may develop into severe hyperglycaemia or ketoacidosis as a result of stress or infection. About thirty per cent of patients with type 1 diabetes may initially exhibit ketoacidosis (DKA) coma. [2]

It is important to document the height, weight, and body mass index (BMI) of individuals with diabetes mellitus. An ophthalmologist must rule out retinopathy in these patients. All pulses should be palpated to examine for peripheral arterial disease. Neuropathy should be ruled out by physical examination and history.

Evaluation:

Screening

Individuals over 40 should get screening every year. For those who have other diabetes risk factors, more frequent screening is advised. [6] [7] [8] [9] [10]

- Some racial or ethnic groups, such as Asian Americans, Pacific Islanders, Native Americans, African Americans, and Hispanics,
- People who are overweight or obese and have a BMI of 25 kg/m2 or higher—23 kg/m2 for Asian Americans—
- A first-degree relative who has diabetes
- History of high blood pressure or heart disease
- either hypertriglyceridemia or low HDL cholesterol,
- Polycystic Ovarian Syndrome in women
- Physical inactivity
- Acanthosis nigricans is one condition linked to insulin resistance.

At least every three years, women with gestational diabetes mellitus (GDM) should have lifelong testing. Testing should start for all other patients at age 45, and if the results are normal, the patient should be tested at least every three years. Diabetes is screened for and diagnosed using the same methods. Additionally, these tests identify people who have prediabetes.

Diagnosis

The haemoglobin A1c criterion or plasma glucose concentration (fasting or 2-hour postprandial plasma glucose) can be used to diagnose diabetes.

Fasting Plasma Glucose (FPG)

After an overnight fast of eight hours, a blood sample is obtained. A fasting plasma glucose (FPG) level of greater than 126 mg/dL (7.0 mm/L) is compatible with the diagnosis, according to the American Diabetes Association.

Two-Hour Oral Glucose Tolerance Test (OGTT)

This test measures the plasma glucose level both before and two hours after consuming 75 grams of glucose. If the 2-hour sample's plasma glucose (PG) level is greater than 200 mg/dL (11.1 mmol/L), diabetes mellitus is diagnosed. Although it is also a routine test, it has significant variability problems and is more expensive and inconvenient than FPG. For three to five days, patients must avoid taking any medications that may affect their glucose tolerance, such as thiazide diuretics and steroids, and follow a diet that includes at least 150 g of carbs per day.

Glycated Hemoglobin (Hb) A1C

This test provides the blood glucose average for the previous two to three months. DM is diagnosed in patients whose Hb A1C is more than 6.5% (48 mmol/mol). The Hb A1C test is quick, easy, standardized, and exhibits minimal variation because of pre-analytical factors. Stress and acute illness have little effect on it.

Reduced sensitivity is one of the many problems with Hb A1C, which is also expensive. The National Glycohemoglobin Standardization Program (NGSP)-certified method standardized to the Diabetes Control and Complications Trial (DCCT) assay should be used to assess hemoglobin A1C. Many illnesses, including sickle cell disease, pregnancy, hemodialysis, blood loss or transfusion, and erythropoietin therapy, might influence it. In non-white populations, it has not been thoroughly validated.

Its usage is restricted in nations where anemia is highly prevalent because anemia brought on by iron or vitamin B12 deficiency causes a false rise of Hb A1C. Additionally, there is a less-than-ideal relationship between Hb A1C and FPG in children and the elderly.

To diagnose diabetes mellitus, all of the aforementioned tests should be performed again later if the patient is asymptomatic. Random plasma glucose levels greater than 200 mg/dL are also adequate to diagnosis diabetes mellitus in patients exhibiting the usual signs of hyperglycemia, such as increased hunger, thirst, and urine.

For the diagnosis of DM, FPG, 2-hour PG during 75-g GTT, and Hb A1C are all equally suitable. The outcomes of these tests do not agree with one another.

Diagnosis of Gestational Diabetes Mellitus

At 24 to 28 weeks of gestation, pregnant women who have never been diagnosed with diabetes should get tested for GDM. The American College of Obstetrics and Gynecology (ACOG) and the American Diabetes Association (ADA) advise diagnosing GDM in one or two steps.

One-Step Strategy

An overnight fast is followed by a 75 gm OGTT. Blood samples are taken during the one- and two-hour fast. If the fasting glucose level is 92 mg/dl (5.1 mmol/l), the 1-hour serum glucose level is 180 mg/dl (10.0 mmol/l), or the 2-hour serum glucose level is 153 mg/dl (8.5 mmol/l), GDM is diagnosed.

Two-Step Strategy

- Step 1: Regardless of the last meal, conduct a 50-gram glucose challenge test. Go to step 2 if, one hour after the load, the PG is greater than or equal to 140 mg/dl (7.8 mmol/l).
- Step 2: Following an overnight fast, a 100 g glucose OGTT is conducted. The cutoff values are 180 or 190 mg/dl (10.0/10.6 mmol/l) for one hour, 155 or 165 mg/dl (8.6/9.2 mmol/l) for two hours, 140 or 145 mg/dl (7.8/8.0 mmol/l) for three hours, and 95 or 105 mg/dl (5.5/5.8 mmol/l) for fasting. If two or more PG values match or surpass these cutoffs, GDM is diagnosed.

Treatment / Management:

Diet and exercise are the cornerstones of treatment for both type 1 and type 2 diabetes. [11] [12] [13]. It is necessary to promote a diet that is high in fiber and monounsaturated fats and low in processed carbs, saturated fat, and high fructose corn syrup. 90 to 150 minutes a week of aerobic activity is also advantageous. Weight loss is the main goal for obese T2DM patients.
The first-line treatment is metformin if sufficient glycemia cannot be reached. Many other treatments, including oral sulfonylureas and dipeptidyl peptidase-4 (DPP-4) inhibitors, are used after metformin. Available medications include insulin, alpha-glucosidase inhibitors, pioglitazone, sodium-glucose co-transporter-2 (SGLT2) inhibitors, glucagon-like peptide-1 (GLP-I) receptor agonists, and pioglitazone, particularly in patients with fatty liver disease. According to recent research, liraglutide, a GLP-1 receptor agonist, and empagliflozin (EMPA), an SGLT2 inhibitor, both significantly lower mortality and cardiovascular (CV) events. Therefore, these medications must to be taken into consideration next for individuals with CV illness. The cornerstone of treatment for individuals with type 1 diabetes is a basal-bolus insulin regimen. Insulin pump therapy is also a sensible option. Treatments that do not cause hypoglycemia, such as DPP-4 inhibitors, SGLT-2 inhibitors, GLP-I receptor agonists, and pioglitazone with metformin, should be preferred because hypoglycemia is a sign of increased mortality. Other benefits of SGLT-2 inhibitors and GLP-I receptor agonists include decreased albuminuria, blood pressure (BP), and body weight.

The target Hb A1C should be less than 7% in order to minimize microvascular problems in most people. Additionally, the target blood pressure should be below 130/85 mmHg, with angiotensin-converting enzyme (ACE)/angiotensin receptor blocker (ARB) medication being preferred. Urine albumin excretion and fundal checks should be performed at least twice a year, as advised by guidelines.

A LDL-C level of less than 100 mg/dl in the absence of atherosclerotic cardiovascular disease (ASCVD) or less than 70 mg/dl in the presence of ASCVD should be the target for the lipid panel. Since statins lower CV events and mortality, they are the recommended medication. For ASCVD patients who are not meeting their goals, think about adding PCSK9 inhibitors and ezetimibe.

We have just described the fundamentals of therapy because the many issues and treatments have been covered in length in earlier StatPearls review articles. [14] [15]

Differential Diagnosis:

The following illnesses are on the differential diagnosis list for diabetes mellitus because they might have similar signs and symptoms: [16] [17]

- Drug-induced signs and symptoms due to corticosteroids, neuroleptics, pentamidine, etc.
- Genetic aberrations in beta-cell function and insulin action
- Metabolic syndrome (syndrome X)[18]
- Infection

- Endocrinopathies such as acromegaly, Cushing disease, pheochromocytoma, hypothyroidism, etc.[19]
- Complications of iron overload (hemochromatosis)
- Conditions affecting the exocrine part of the pancreas such as pancreatitis, cystic fibrosis, etc.[20]

Prognosis:

Since diabetes mellitus is linked to an increased risk of atherosclerotic cardiovascular disease (ASCVD), lowering blood pressure, taking statins, exercising frequently, and quitting smoking are all crucial steps in reducing risk. Although it varies greatly, the overall excess mortality rate among people with type 2 diabetes is about 15% higher. The prevalence of vision-threatening diabetic retinopathy in the United States is about 4.4% among adults with diabetes, while it is 1% for end-stage renal disease. Today, with pharmacotherapy for hyperglycemia, as well as lowering LDL cholesterol and managing blood pressure with ACE/ARB therapy, with other antihypertensive medications and aspirin in secondary prevention, vascular complications can be managed adequately, resulting in a reduction in morbidity and mortality. [21] [22]

Complications:

In unmanaged diabetes mellitus, persistent hyperglycemia can lead to a number of acute and long-term problems. One of the main causes of cardiovascular disease (CVD), blindness, kidney failure, and lower limb amputation is diabetes mellitus. Hypoglycemia, diabetic ketoacidosis, hyperglycemic hyperosmolar condition, and hyperglycaemic diabetic coma are examples of acute consequences. Nephropathy, neuropathy, and retinopathy are examples of chronic microvascular complications; coronary artery disease (CAD), peripheral artery disease (PAD), and cerebrovascular disease are examples of chronic macrovascular consequences. According to estimates, between 1.4 and 4.7% of middle-aged diabetics experience a CVD incident annually. [23] [24]

Deterrence and Patient Education:

In order to prevent issues related to diabetes mellitus, patients need to be informed about the significance of blood glucose control. Lifestyle management, which includes exercise and nutrition control, must be emphasized. Blood glucose self-monitoring is a crucial way for people to take charge of their diabetes care. Lipid, glucose, and glycated hemoglobin levels must be regularly estimated.

Patients should be informed by healthcare providers about the signs of hypoglycemia, including tachycardia, perspiration, and disorientation, as well as the necessary treatment, which involves consuming 15 to 20 grams of carbohydrates.

It is important to encourage patients to give up smoking. Regular foot care and vision exams must be prioritized.

Pearls and Other Issues:

- T1DM is characterized by the autoimmune destruction of pancreatic beta cells in the majority.
- T2DM is caused due to duel defects in insulin resistance and insulin secretion.
- Gestational diabetes is associated with maternal as well as fetal complications.
- Exercise and a healthy diet are beneficial in both type 1 and type 2 diabetes mellitus.
- Novel therapies, such as GLP-1 receptor agonists and SGLT2 inhibitors, are safer since they do not cause hypoglycemia, are weight neutral or result in weight loss and blood pressure and impact vascular complications favorably.

Enhancing Healthcare Team Outcomes:

Type 2 diabetes mellitus is diagnosed and treated by an interdisciplinary team. These individuals require a suitable referral to the vascular surgeon, cardiologist, nephrologist, and ophthalmologist. Patients must also be informed about lifestyle modifications that can assist lower blood sugar levels. Every obese patient should be urged to eat a balanced diet, exercise, and lose weight. All individuals with diabetes must be encouraged to quit smoking and refrain from consuming alcohol by their primary care physician and diabetic nurse. Diabetes mellitus has life-threatening consequences that significantly lower quality of life. [25] [26] [27]

References:

1. Zheng Y, Ley SH, Hu FB. Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. Nat Rev Endocrinol. 2018 Feb;14(2):88-98. [PubMed]
2. Malek R, Hannat S, Nechadi A, Mekideche FZ, Kaabeche M. Diabetes and Ramadan: A multicenter study in Algerian population. Diabetes Res Clin Pract. 2019 Apr;150:322-330. [PubMed]
3. Choi YJ, Chung YS. Type 2 diabetes mellitus and bone fragility: Special focus on bone imaging. Osteoporos Sarcopenia. 2016 Mar;2(1):20-24. [PMC free article] [PubMed]
4. Picke AK, Campbell G, Napoli N, Hofbauer LC, Rauner M. Update on the impact of type 2 diabetes mellitus on bone metabolism and material properties. Endocr Connect. 2019 Mar 01;8(3):R55-R70. [PMC free article] [PubMed]
5. Carrillo-Larco RM, Barengo NC, Albitres-Flores L, Bernabe-Ortiz A. The risk of mortality among people with type 2 diabetes in Latin America: A systematic review and meta-analysis of population-based cohort studies. Diabetes Metab Res Rev. 2019 May;35(4):e3139. [PubMed]
6. Hussain S, Chowdhury TA. The Impact of Comorbidities on the Pharmacological Management of Type 2 Diabetes Mellitus. Drugs. 2019 Feb;79(3):231-242. [PubMed]
7. Kempegowda P, Chandan JS, Abdulrahman S, Chauhan A, Saeed MA. Managing hypertension in people of African origin with diabetes: Evaluation of adherence to NICE Guidelines. Prim Care Diabetes. 2019 Jun;13(3):266-271. [PubMed]
8. Martinez LC, Sherling D, Holley A. The Screening and Prevention of Diabetes Mellitus. Prim Care. 2019 Mar;46(1):41-52. [PubMed]

9. Thewjitcharoen Y, Chotwanvirat P, Jantawan A, Siwasaranond N, Saetung S, Nimitphong H, Himathongkam T, Reutrakul S. Evaluation of Dietary Intakes and Nutritional Knowledge in Thai Patients with Type 2 Diabetes Mellitus. J Diabetes Res. 2018;2018:9152910. [PMC free article] [PubMed]
10. Willis M, Asseburg C, Neslusan C. Conducting and interpreting results of network meta-analyses in type 2 diabetes mellitus: A review of network meta-analyses that include sodium glucose co-transporter 2 inhibitors. Diabetes Res Clin Pract. 2019 Feb;148:222-233. [PubMed]
11. Lai LL, Wan Yusoff WNI, Vethakkan SR, Nik Mustapha NR, Mahadeva S, Chan WK. Screening for non-alcoholic fatty liver disease in patients with type 2 diabetes mellitus using transient elastography. J Gastroenterol Hepatol. 2019 Aug;34(8):1396-1403. [PubMed]
12. Eckstein ML, Williams DM, O'Neil LK, Hayes J, Stephens JW, Bracken RM. Physical exercise and non-insulin glucose-lowering therapies in the management of Type 2 diabetes mellitus: a clinical review. Diabet Med. 2019 Mar;36(3):349-358. [PubMed]
13. Massey CN, Feig EH, Duque-Serrano L, Wexler D, Moskowitz JT, Huffman JC. Well-being interventions for individuals with diabetes: A systematic review. Diabetes Res Clin Pract. 2019 Jan;147:118-133. [PMC free article] [PubMed]
14. Shah SR, Iqbal SM, Alweis R, Roark S. A closer look at heart failure in patients with concurrent diabetes mellitus using glucose lowering drugs. Expert Rev Clin Pharmacol. 2019 Jan;12(1):45-52. [PubMed]
15. Chinese Diabetes Society; National Offic for Primary Diabetes Care. [National guidelines for the prevention and control of diabetes in primary care(2018)]. Zhonghua Nei Ke Za Zhi. 2018 Dec 01;57(12):885-893. [PubMed]
16. Petersmann A, Müller-Wieland D, Müller UA, Landgraf R, Nauck M, Freckmann G, Heinemann L, Schleicher E. Definition, Classification and Diagnosis of Diabetes Mellitus. Exp Clin Endocrinol Diabetes. 2019 Dec;127(S 01):S1-S7. [PubMed]
17. Kerner W, Brückel J., German Diabetes Association. Definition, classification and diagnosis of diabetes mellitus. Exp Clin Endocrinol Diabetes. 2014 Jul;122(7):384-6. [PubMed]
18. Cepeda Marte JL, Ruiz-Matuk C, Mota M, Pérez S, Recio N, Hernández D, Fernández J, Porto J, Ramos A. Quality of life and metabolic control in type 2 diabetes mellitus diagnosed individuals. Diabetes Metab Syndr. 2019 Sep-Oct;13(5):2827-2832. [PubMed]
19. Steffensen C, Dekkers OM, Lyhne J, Pedersen BG, Rasmussen F, Rungby J, Poulsen PL, Jørgensen JOL. Hypercortisolism in Newly Diagnosed Type 2 Diabetes: A Prospective Study of 384 Newly Diagnosed Patients. Horm Metab Res. 2019 Jan;51(1):62-68. [PubMed]
20. Qin Z, Zhou K, Li Y, Cheng W, Wang Z, Wang J, Gao F, Yang L, Xu Y, Wu Y, He H, Zhou Y. The atherogenic index of plasma plays an important role in predicting the prognosis of type 2 diabetic subjects undergoing percutaneous coronary intervention: results from an observational cohort study in China. Cardiovasc Diabetol. 2020 Feb 21;19(1):23. [PMC free article] [PubMed]
21. Nowakowska M, Zghebi SS, Ashcroft DM, Buchan I, Chew-Graham C, Holt T, Mallen C, Van Marwijk H, Peek N, Perera-Salazar R, Reeves D, Rutter MK, Weng SF, Qureshi N, Mamas MA, Kontopantelis E. Correction to: The comorbidity burden of type 2 diabetes mellitus: patterns, clusters and predictions from a large English primary care cohort. BMC Med. 2020 Jan 25;18(1):22. [PMC free article] [PubMed]

22. Akalu Y, Birhan A. Peripheral Arterial Disease and Its Associated Factors among Type 2 Diabetes Mellitus Patients at Debre Tabor General Hospital, Northwest Ethiopia. J Diabetes Res. 2020;2020:9419413. [PMC free article] [PubMed]
23. Patoulias D, Papadopoulos C, Stavropoulos K, Zografou I, Doumas M, Karagiannis A. Prognostic value of arterial stiffness measurements in cardiovascular disease, diabetes, and its complications: The potential role of sodium-glucose co-transporter-2 inhibitors. J Clin Hypertens (Greenwich). 2020 Apr;22(4):562-571. [PMC free article] [PubMed]
24. Liakopoulos V, Franzén S, Svensson AM, Miftaraj M, Ottosson J, Näslund I, Gudbjörnsdottir S, Eliasson B. Pros and cons of gastric bypass surgery in individuals with obesity and type 2 diabetes: nationwide, matched, observational cohort study. BMJ Open. 2019 Jan 15;9(1):e023882. [PMC free article] [PubMed]
25. Su YJ, Chen TH, Hsu CY, Chiu WT, Lin YS, Chi CC. Safety of Metformin in Psoriasis Patients With Diabetes Mellitus: A 17-Year Population-Based Real-World Cohort Study. J Clin Endocrinol Metab. 2019 Aug 01;104(8):3279-3286. [PubMed]
26. Choi SE, Berkowitz SA, Yudkin JS, Naci H, Basu S. Personalizing Second-Line Type 2 Diabetes Treatment Selection: Combining Network Meta-analysis, Individualized Risk, and Patient Preferences for Unified Decision Support. Med Decis Making. 2019 Apr;39(3):239-252. [PMC free article] [PubMed]